

SUPPLEMENT TO REVISION OF NEW WORLD *CHAENUSA* HALIDAY
SENSU LATO (HYMENOPTERA: BRACONIDAE: ALYSIINAE)

ROBERT R. KULA, JUAN JOSÉ MARTINEZ, AND GUILLERMO CABRERA WALSH

(RRK) Systematic Entomology Laboratory, PSI, Agricultural Research Service, U.S. Department of Agriculture, c/o National Museum of Natural History, Smithsonian Institution, P.O. Box 37012, MRC 168, Washington, DC 20013-7012, U.S.A. (e-mail: Robert.Kula@ars.usda.gov); (JJM) División Entomología, Museo Argentino de Ciencias Naturales “Bernardino Rivadavia,” Angel Gallardo 470, Buenos Aires, C1405DJR, Argentina (e-mail: jjmartinez@macn.gov.ar); (GCW) USDA/ARS/South American Biological Control Laboratory, Bolivar 1559, 1686 Hurlingham, Buenos Aires, Argentina (e-mail: gcabrera@speedy.com.ar)

Abstract.—*Chaenusa aurantium* Kula and Martinez, new species and *Chaenusa steineri* Kula, new species, both from the Neotropical Region, are described. The former species was reared from an undescribed species of *Hydrellia* Robineau-Desvoidy (Diptera: Ephydriidae) in Argentina under evaluation for control of *Egeria densa* (Planch.) (Alismatales: Hydrocharitaceae), Brazilian waterweed, in the United States. *Chaenusa pallidinervis* (Brèthes), also from the Neotropical Region, is redescribed. New distribution records are reported for *Chaenusa americana* (Riegel), *Chaenusa bergi* (Riegel), *Chaenusa quadriceps* (Ashmead), *Chaenusa trumani* Kula, *Chaenusa whartoni* Kula, and *Chaenusa woolleyi* Kula from the Nearctic Region, as well as *Chaenusa ireneae* Kula from the Neotropical Region. These data supplement a recently published revision of New World *Chaenusa* Haliday sensu lato.

Key Words: Dacnusiini, Hydrocharitaceae, Brazilian waterweed, Nearctic, Neotropical, biological control, new records, new species, parasitoid, taxonomy

Kula and Zolnerowich (2008) revised the New World species of *Chaenusa* Haliday sensu lato. As far as is known, all are parasitoids of ephydrid flies in the genus *Hydrellia* Robineau-Desvoidy. Six new species were described, three species were transferred to *Chaenusa* from other genera, and four previously described species were proposed to be junior subjective synonyms resulting in 13 valid species. The generic placement of *Chaenusa pallidinervis* (Brèthes) was tentative because the holotype, deposited in the

Museo Argentino de Ciencias Naturales “Bernardino Rivadavia,” Buenos Aires, Argentina (MACN), was not available for examination. New host records were reported for two species, new distribution records were reported for four species, and a key to species was provided, as was the taxonomic history for each species.

Additional New World specimens of *Chaenusa* s.l. were acquired following completion of Kula and Zolnerowich (2008). Examination of the specimens resulted in the discovery of two undescribed species, one of which was reared

* Accepted by Michael W. Gates

from an undescribed species of *Hydrellia* infesting *Egeria densa* (Planch.), Brazilian waterweed, in Argentina. The USGS Nonindigenous Aquatic Species (NAS) database (<http://nas.er.usgs.gov/Default.asp>) and the USDA PLANTS database (USDA, NRCS 2008) report Brazilian waterweed from 38 states and Puerto Rico. It is reported from Minnesota in the former database but not the latter; it is reported from Colorado, Ohio, West Virginia, and Puerto Rico in the latter database but not the former. It is listed as a noxious weed in eight states (USDA, NRCS 2008). The undescribed species of *Hydrellia* is a candidate for classical biological control of Brazilian waterweed in the United States; laboratory and field tests for this species are in progress in Argentina. Examination of the specimens also resulted in the discovery of new distribution records for seven species. Further, the holotype of *C. pallidinervis* was located in MACN and examined. The purpose of this article is to describe the two undescribed species, report the new distribution records, verify the placement of and redescribe *C. pallidinervis*, and update the key to New World species of *Chaenusa* s.l. in Kula and Zolnerowich (2008).

MATERIALS AND METHODS

Most specimens used in this study are housed in the Smithsonian Institution National Museum of Natural History, Washington, DC, USA (USNM) or were acquired from the following repositories: Canadian National Collection of Insects, Ottawa, Ontario (CNCI); the insect collection at Eastern Illinois University, Charleston, USA (EIU); MACN; Museo de La Plata, La Plata, Argentina (MLP); and the insect collection at Texas A&M University, College Station, USA (TAMU). Specimens of the undescribed species from Argentina were reared as follows. Plant material, consisting of 40-cm plant tips, 50 tips per site, was

collected in the field in 24-liter trays with perforated lids. Plant tips were inspected on the day of collection using a stereomicroscope in the laboratory. *Hydrellia* puparia were excised along with the stem section in which they were inserted and incubated at $25 \pm 2^\circ\text{C}$ in 2-liter plastic containers filled with tap water and fitted with screen lids. A second inspection of the plant material was performed after 15 to 20 days in order to collect fly puparia that were larvae during the first inspection. These were incubated under the same conditions as described above. The containers were inspected three times a week to record puparia that produced *Hydrellia* adults, parasitoids, or disease.

Most specimens were dehydrated following Heraty and Hawks (1998) and subsequently point mounted and labeled, but several were dehydrated, point mounted, and labeled prior to this study. All were examined using a Leica Wild M10 stereomicroscope with $25\times$ oculars. The first author determined that all are *Chaenusa* s.l. as defined in Kula and Zolnerowich (2008) and examined the holotypes of all New World species of *Chaenusa* s.l. (repositories listed in Kula and Zolnerowich 2008) to confirm species determinations and that two were undescribed. Riegel (1950, 1982) treated *Chaenusa* sensu Kula and Zolnerowich (2008) as *Chaenusa* sensu stricto, *Chorebidea* Viereck, and *Chorebidella* Riegel. Kula and Zolnerowich (2008) discussed the definition of each genus and problems with placing species of *Chaenusa* s.l. in those genera.

Measurements were taken with an ocular micrometer as in Wharton (1977) with additions and modifications as in Kula and Zolnerowich (2005). Body length was measured as in Kula and Zolnerowich (2008), and scutellar sulcus length and width were measured as in Kula (2009). The following abbreviations are used in the descriptions: head

length (HL), head width (HW), temple width (TW), face width (FW), face height (FH), eye length (EL), eye height (EH), flagellomere 1 length (F1L), flagellomere 2 length (F2L), mesosoma length (ML), mesoscutum width (MW), mesosoma height (MH), scutellar sulcus length (SSL), scutellar sulcus width (SSW), median tergite 1 length (T1L), median tergite 1 width (T1W), and median tergites one through eight (t1...t8).

Terminology for anatomical features, surface sculpture, and setation follows Sharkey and Wharton (1997) except gonoforceps is as in Wharton (1977). As defined in Sharkey and Wharton (1997), setiferous and setose both refer to areas bearing setae, setiferous areas "not necessarily with dense setae" and setose areas "with dense setae." The recognition and numbering of teeth follow Kula (2008). Tooth shape is described as observed from the following angles: tooth one in dorsal view, tooth two in lateral view, and tooth three in dorsolateral view. The pronope is described as apparently present or absent when it is small and difficult to differentiate from sculpture and/or grooves within the pronotal collar. Forewing stigma shape is described as apparently elongate when the distal portion of the stigma gradually tapers into vein R1a so that the distal endpoint of the stigma cannot be discerned unequivocally. Color is described exactly as it appeared at the time of examination. Improperly dehydrated and/or preserved specimens may deviate from their natural color, and telescoping of the metasoma may affect how color is interpreted. Thus, color should be used with caution when identifying specimens that have been air-dried or stored in alcohol at room temperature for a long period of time. When a range of intraspecific variation is reported, the most common condition is the first condition mentioned.

The material examined sections are formatted as in Kula and Zolnerowich (2008). With the exception of EIU, codens for repositories are as in Evenhuis (2008). Species distributions were considered at the state-level for the United States. Equivalent units were used for other countries. Asterisks indicate new distribution records. Scanning electron micrographs were captured using an Amray 1810 scanning electron microscope for stub-mounted specimens coated with gold/palladium alloy and a Philips XL30 ESEM environmental scanning electron microscope for uncoated specimens. Images of wings were taken using an EntoVision Imaging Suite consisting of a firewire JVC KY-75 3CCD digital camera mounted to a Leica DMRB compound microscope. The camera fed image data to a desktop computer where Cartograph 7.0.0.3 and Archimed 5.5.0.1 were used to generate a composite image from a set of images captured at multiple focal planes.

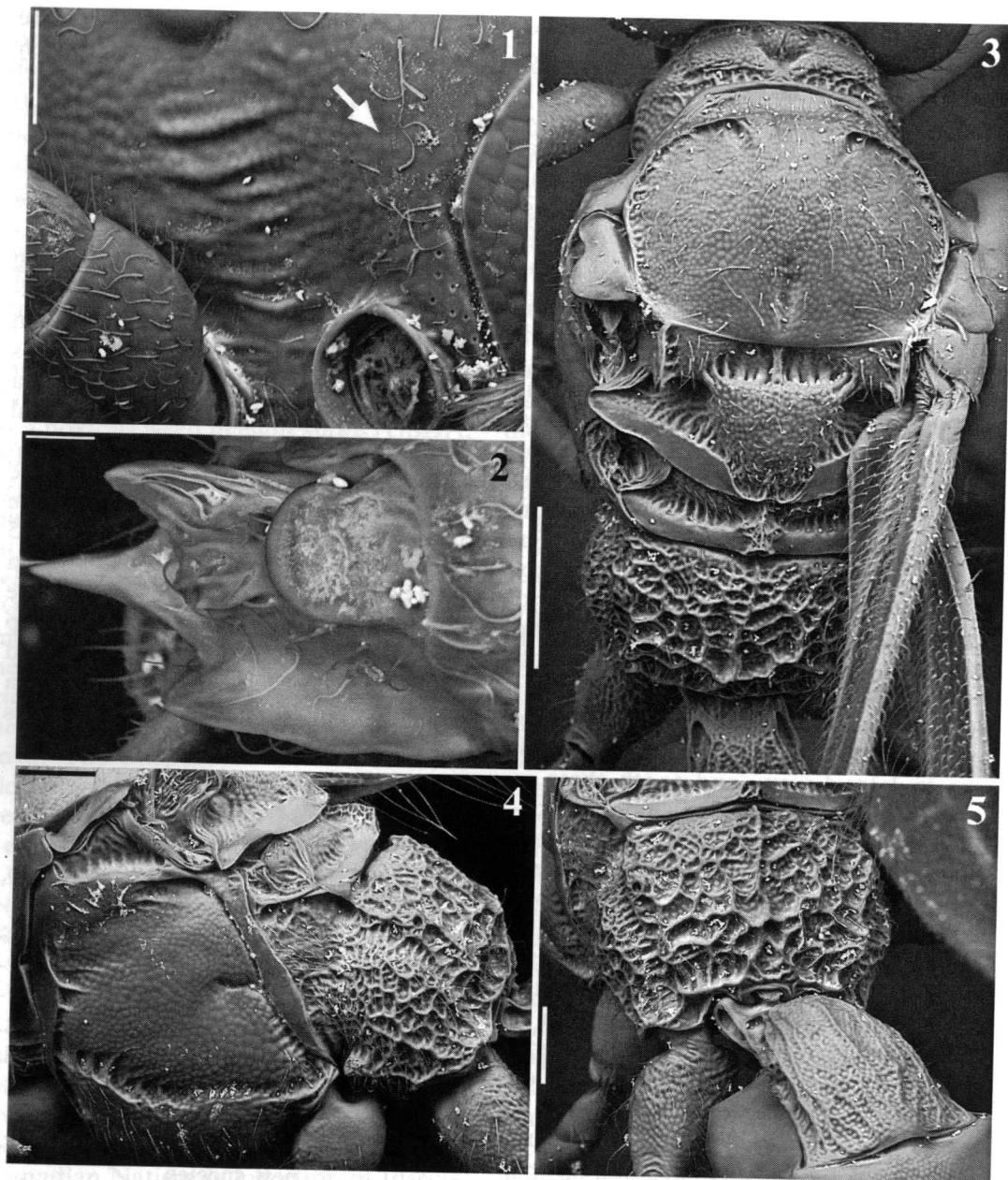
RESULTS AND DISCUSSION

Chaenusa americana (Riegel)

Distribution.—CANADA: Ontario, Quebec; MEXICO: Jalisco; USA: Florida, Maryland, Michigan, Texas, Wisconsin (Riegel 1982, Kula and Zolnerowich 2008). USA, 1 ♀ 1 ♂ *CONNECTICUT: New Haven Co., Mt. Carmel, Mill River, 2.viii.1947, K. M. Sommerman, on lily pad (EIU).

Chaenusa aurantium Kula and Martinez, new species (Figs. 1–7)

Diagnosis.—*Chaenusa aurantium*, *C. pallidinervis*, and *Chaenusa steineri* Kula, new species are the only New World species of *Chaenusa* s.l. with a three-toothed mandible in combination with a closed forewing first subdiscal cell. All other New World species have either a four-toothed mandible or a three-



Figs. 1-5. *Chaenusa aurantium*. 1, Frons, anterolateral view; arrow = setiferous laterally, scale bar = 50 μ m. 2, Mandible, lateral view; scale bar = 20 μ m. 3, Mesosoma, dorsal view; scale bar = 200 μ m. 4, Mesosoma, lateral view; scale bar = 100 μ m. 5, Mesosoma and tergum 1, posterodorsal view; scale bar = 100 μ m.

toothed mandible in combination with an open first subdiscal cell. *Chaenusa aurantium* can be differentiated from *C. pallidinervis* and *C. steineri* using the following characters. The terminal max-

illary palpomere is brown in *C. aurantium* and is yellow in *C. pallidinervis* and *C. steineri*. The frons is setiferous laterally and glabrous mesally in *C. aurantium* and is entirely glabrous in *C.*

pallidinervis and *C. steineri*. The head is orange in female *C. aurantium* except the ocellar triangle is brown; the head is entirely brown in female *C. pallidinervis* and *C. steineri*. The frons is transversely rugose to rugulose mesally and coriaceous laterally, the vertex is coriaceous with the median longitudinal sulcus often (60%) transversely rugose, and the gena is coriaceous to weakly coriaceous in *C. aurantium*; the head is entirely smooth in *C. pallidinervis*. The mesoscutal midpit is oval in *C. aurantium* and is absent in *C. pallidinervis*. The flat area anterior to the metapleural swelling is rugose in *C. aurantium* and is smooth in *C. pallidinervis*. *Chaenusa aurantium* has frons transversely rugose to rugulose mesally and coriaceous laterally, vertex coriaceous with median longitudinal sulcus often (60%) transversely rugose, gena coriaceous to weakly coriaceous, mesoscutal midpit oval, mesopleuron coriaceous, and flat area anterior to metapleural swelling rugose; *C. pallidinervis* has head entirely smooth, mesoscutal midpit absent, mesopleuron smooth, and flat area anterior to metapleural swelling smooth. *Chaenusa aurantium* has 18 and 21–22 flagellomeres for females and males, respectively, ML $2.12\text{--}2.27\times$ MW, ML $1.53\text{--}1.62\times$ MH, and T1L $1.25\text{--}1.58\times$ T1W; *C. steineri* has 23 and 24–25 flagellomeres for females and males, respectively, ML $2.74\text{--}2.81\times$ MW, ML $1.90\text{--}2.05\times$ MH, and T1L $1.94\text{--}2.20\times$ T1W.

Description.—Female. *Body length:* 2.42–2.94 mm. *Head:* HL $0.71\text{--}0.74\times$ HW, HW $0.94\times$ TW, FW $0.60\times$ FH, EL $0.40\text{--}0.41\times$ EH, MNL $1.88\text{--}2.00\times$ MNAW, MNAW $0.78\text{--}0.80\times$ MNBW, F1L $1.27\text{--}1.56\times$ F2L; antenna with 18 flagellomeres, maxillary palpus six-segmented, labial palpus three-segmented; face smooth, setose; frons (Fig. 1) transversely rugose to rugulose mesally and coriaceous laterally, setiferous laterally and glabrous mesally; gena weakly cori-

aceous to coriaceous and vertex coriaceous except one specimen with median longitudinal sulcus transversely rugose to occiput, setiferous; occiput weakly coriaceous or smooth, glabrous; eye setiferous; clypeus with apical rim, setiferous; mandible (Fig. 2) with three teeth, setiferous except excavated distal portion glabrous, longitudinally rugulose mesally but mesal horizontal ridge and diagonal ridges associated with tooth 1 and 3 indiscernible, tooth 1 triangular, rounded apically, tooth 2 narrowly elongate, acute apically, tooth 3 orthogonal, rounded apically.

Mesosoma (Figs. 3–5): ML $2.18\times$ MW, ML $1.55\text{--}1.66\times$ MH, MW $0.71\text{--}0.76\times$ MH, SSL $0.25\text{--}0.29\times$ SSW; pronotal collar coriaceous anteriorly and incompletely crenulate posteriorly (interrupted mesally), one specimen with anterior portion with two grooves converging posteromesally, pronope present or apparently absent but difficult to differentiate from grooves, lateral portion of pronotum coriaceous, setiferous along margins and glabrous mesally, anterolateral furrow coriaceous; notauli anteriorly carinate transverse grooves continuous with lateral margin of mesoscutum, crenulate, terminating anterior to mesoscutal midpit; mesoscutal midpit oval; mesoscutum (excluding lateral margin, notauli, and midpit) coriaceous, setiferous with setae uniformly distributed or slightly less dense posteromesally; scutellar sulcus bearing median longitudinal ridge and several small crenulae; scutellar disc coriaceous, setiferous; metanotal flange present; propodeum areolate-rugose, one specimen with longitudinal carina mesobasally, setiferous; epicnemial carina present laterally but absent ventrally; sternaulus present along entire length of mesopleuron, transitioning from crenulate anteriorly to rugulose or rugose posteriorly; posterior mesopleural furrow smooth dorsal to and crenulate ventral to episternal

scrobe or entirely smooth; mesopleuron (excluding sternaulus and posterior mesopleural furrow) coriaceous except anterior margin partially dorsoventrally crenulate, setiferous dorsally and ventrally but otherwise glabrous; metapleuron with rugose flat triangular area anteriorly and areolate-rugose swelling posteriorly, flat area setiferous, setae generally oriented posteriorly, swelling setiferous, setae generally oriented posteroventrally.

Forewing (Fig. 6): Hyaline; stigma apparently elongate, proximal margin well-defined and distal margin tapering into vein R1a; vein r arising slightly basad middle of enlarged portion of stigma; vein 3RS complete and tubular, evenly curved to anterior margin; veins 2RS, 1 m-cu, and (RS + M)a complete and tubular; vein 1 m-cu basad vein 2RS; 1st subdiscal cell closed, veins 2-1A and 2cu-a complete and tubular.

Hind wing (Fig. 7): Hyaline; basal cell closed; subbasal cell closed or virtually so, veins 1A and cu-a complete and tubular except minute bulla at postero-distal corner of cell.

Metasoma: T1L 1.25–1.30× T1W; subcylindrical, no lateral compression; ovipositor partially exerted, slightly visible dorsally; t1 (Fig. 5) acicula-rugose to coriaceous-rugose, setiferous posterodorsally and laterally, dorsope present; t2 coriaceous; t3 weakly coriaceous; t4–t8 smooth; t2 setiferous posterolaterally, setae located in posterior half of tergite but in no apparent pattern, glabrous posteromesally; t3–t4 setiferous, setae located in posterior half of tergite and approximately in single transverse line, glabrous mesally; t5–t6 setiferous, setae located in posterior half of tergite and approximately in single transverse line; t7–t8 setiferous, setae located in posterior half of tergite and approximately in single transverse line or no apparent pattern.

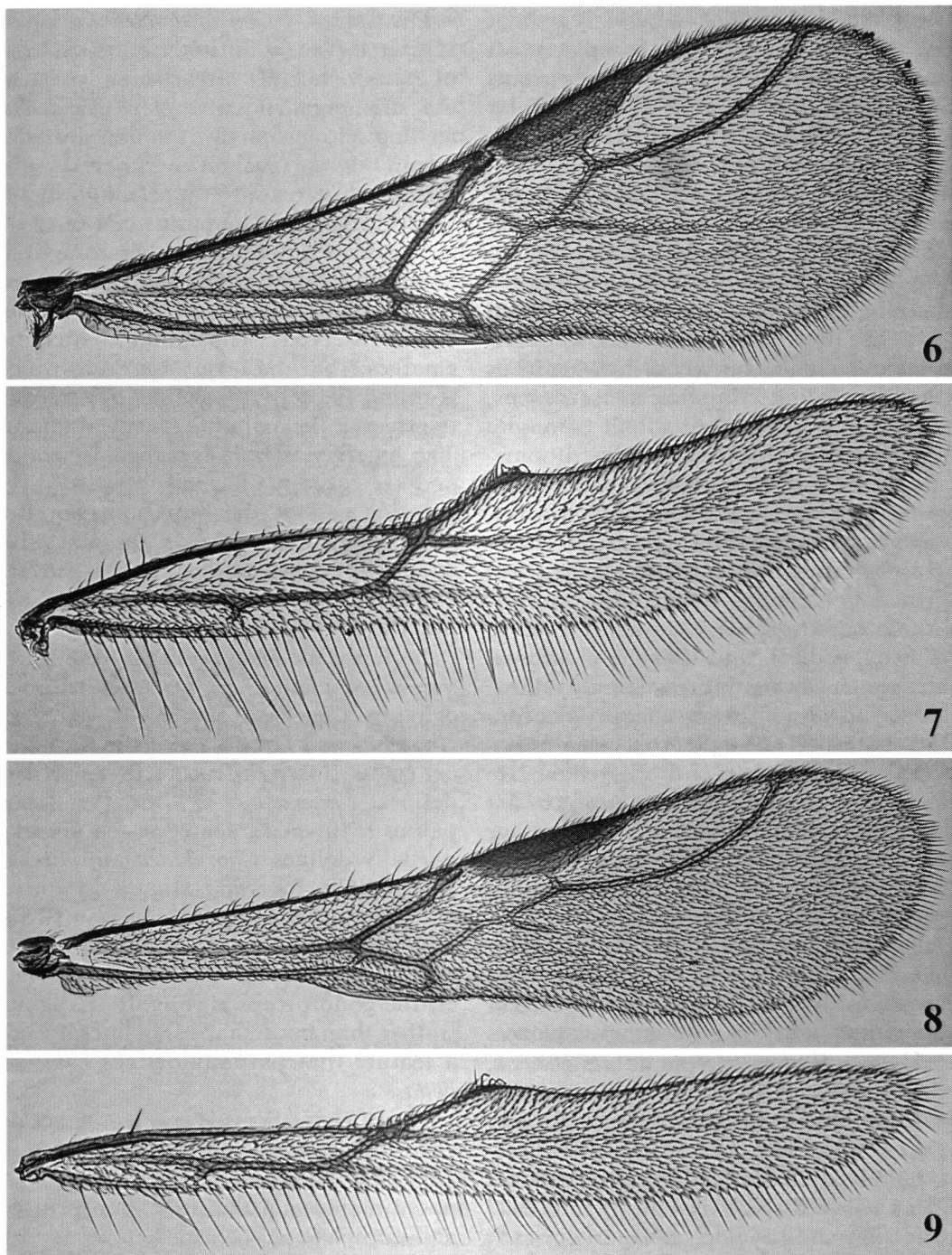
Color: Head (excluding mouthparts and antenna) yellowish orange except

ocellar triangle brown, mandible and palpi yellow except terminal maxillary palpomere brown, scape partially yellow and partially brown, pedicel yellowish brown, flagellum brown; mesosoma yellowish orange except one specimen with mesoscutum brown posteromesally; forewing stigma yellowish brown, wing veins brown; coxa, trochanter, trochantellus, and femur yellow except one specimen with small brown area distally on femur up to articulation point with tibia, tibia brownish yellow, tarsus brown; t1 entirely brownish orange to brown anteriorly and brownish orange posteriorly, t2 entirely yellow to yellow with anterior edge brown, t3–t4 yellow with posterior edge brown, t5–t6 yellow with posterior edge brown to entirely brown, t7–t8 brown.

Male. As in female except: *Head*: HL 0.73–0.80× HW, HW 0.91–0.94× TW, FW 0.90–1.05× FH, EL 0.44–0.48× EH, MNL 2.00–2.14× MNAW, MNAW 0.70–0.73× MNBW; antenna with 21–22 flagellomeres; face rugulose; clypeus setiferous to setose; diagonal ridges associated with tooth 1 and 3 of mandible weakly present or absent, tooth 3 triangular or orthogonal.

Mesosoma: ML 2.12–2.27× MW, ML 1.53–1.62× MH, SSL 0.28–0.44× SSW; pronotal collar incompletely (interrupted mesally) or completely crenulate posteriorly, lateral portion of pronotum coriaceous to rugulose, anterolateral furrow coriaceous to rugulose; notauli crenulate to rugulose; scutellar disc coriaceous to weakly coriaceous; metanotal flange present or metanotum with anterior ridge transitioning into dull protuberance posteriorly; sternaulus transitioning from crenulate anteriorly to coriaceous or rugose posteriorly; posterior mesopleural furrow entirely smooth or entirely crenulate, crenulae becoming increasingly conspicuous dorsally to ventrally.

Forewing: Vein (RS + M)a complete or incomplete, tubular or nebulous when



Figs. 6-9. Wings. 6, 7. *Chaenusa aurantium*. 6, Forewing. 7, Hind wing. 8, 9. *Chaenusa steineri*. 8, Forewing. 9, Hind wing.

complete and absent anteriorly except for small stub when incomplete; 1st subdisal cell closed or virtually so, veins 2-1A and 2cu-a complete and tubular except one specimen with minute bulla at posterodistal corner of cell.

Metasoma: T1L 1.40–1.58 × T1W; t2 setiferous posterolaterally, setae in no apparent pattern or approximately in single transverse line, glabrous posteromesally; t3 setiferous, setae located in posterior half of tergite and approximately in single transverse line, glabrous mesally or line complete; t4 setiferous, setae located in posterior half of tergite and approximately in single line.

Color: Head (excluding antenna) with ocellar triangle and frons mesally brown, face, clypeus, mandible, and palpi yellow except terminal maxillary palpomere brown, remaining areas yellow to yellowish brown, scape yellowish brown to brown, pedicel and flagellum brown; mesosoma mottled brown and yellow, lateral portion of pronotum, propleuron, scutellar disc, mesopleuron, and mesosternum mostly or entirely yellow, remaining areas mostly brown; forewing stigma brown; t1 entirely brown or brown except yellowish brown band just posterior to spiracles, t2 brown to yellowish brown, t3 brown to brownish yellow with pair of yellow spots anterolaterally, t4–t7 mottled yellow and brown with each tergite slightly darker than tergite directly anterior in sequence.

Host.—*Hydrellia* sp. ex *E. densa*, Brazilian waterweed.

Material examined.—*Holotype female*: Top label (white; typewritten) = "ARGENTINA: Buenos Aires [:] Otamendi [:] 34.19146 S, 58.87713 W [:] 17.x.2007 G. C. Walsh [:] ex pupa of *Hydrellia* sp.". Second label (red; partially handwritten, partially typewritten) = "HOLOTYPE [:] *Chaenusa aurantium* [:] Kula and Martinez, 2010" (MLP). *Paratypes*: 1 ♀ 3 ♂ same data as holotype (1 ♂ MLP, 1 ♀ 2 ♂ USNM).

Discussion.—*Chaenusa aurantium* parasitizes larvae of an undescribed species of *Hydrellia*. Host larvae mine leaves of the submerged aquatic plant *E. densa*, feeding on mesophyll. It is not clear if a specific larval instar is attacked. The third author reared *C. aurantium* in the laboratory from puparia collected as larvae in the field, and therefore, it is likely a larval-pupal parasitoid. However, oviposition into host larvae has not been observed. The adult parasitoid emerges from the host puparium, which is found fixed by the caudal spiracles in the stem at the axil of the last leaf mined. The emergence hole is irregular-shaped and is usually located towards the anterior end of the puparium but can also be located towards the posterior end. The adult floats to the surface enveloped in a gas bubble from the puparium.

In terms of Riegel (1950, 1982), *C. aurantium* cannot be placed unequivocally in *Chaenusa* s.s., *Chorebidea*, or *Chorebidella*. The forewing first subdisal cell is closed, a feature that partially defines *Chaenusa* s.s., but the labial palpus is three-segmented, a feature that partially defines *Chorebidea* and *Chorebidella*. The forewing stigma is apparently elongate, and forewing vein (RS + M)a is at least partially present, features that partially define *Chorebidea*. However, the gonoforceps is roughly triangular (rather than boot-shaped) in lateral view, a feature that partially defines *Chorebidella*.

Four New World species have an epicnemial carina: *C. aurantium*, *Chaenusa rossi* Riegel, *C. steineri*, and *Chaenusa whartoni* Kula. It is conspicuous and complete in *C. whartoni*, conspicuous but incomplete in *C. rossi*, and inconspicuous and incomplete in *C. aurantium* and *C. steineri*.

Chaenusa aurantium exhibits sexual dimorphism in flagellomere number (18 females, 21–22 males) and FW:FH ratio

(0.60 females, 0.90–1.05 males). Kula and Zolnerowich (2008) observed this pattern in all New World species of *Chaenusa* s.l. known from females and males, and it was also observed in *Chaenusa glabra* Kula from the Oriental Region (Kula 2009).

Etymology.—The specific epithet “*aurantium*” is Latin for orange and refers to the predominately orange head and mesosoma in females.

Chaenusa bergi (Riegel)

Distribution.—USA: California, Connecticut, Kansas, Michigan, Minnesota, New York (Riegel 1950, Kula and Zolnerowich 2008). USA, 2 ♀ 2 ♂ *ALASKA: Matanuska-Susitna Borough, Matanuska Valley, 5.viii.1950, C. O. Berg; 1 ♂ same data as previous except 20.vii.1950 (EIU).

Chaenusa ireneae Kula

Distribution.—CHILE: LOS LAGOS (REGION X): Chiloé, Osorno (Kula and Zolnerowich 2008). *GUATEMALA, 1 ♂ TOTONICAPÁN: San Cristóbal Totoncapán, 13.vi.1966, Flint & Ortiz (USNM).

Chaenusa pallidinervis (Brèthes)

Gyrocampa pallidinervis Brèthes 1913: 42 [MACN, examined].

Chorebus pallidinervis: Riegel 1952: 178 [generic combination].

Chaenusa pallidinervis: Fischer 1997: 139 [generic combination].

Diagnosis.—Characters used to differentiate *C. pallidinervis* from all New World species of *Chaenusa* s.l. other than *C. steineri* are presented in the diagnosis for *C. aurantium*. *Chaenusa pallidinervis* can be differentiated from *C. steineri* using the following characters. *Chaenusa pallidinervis* has frons entirely smooth, ML $2.26 \times$ MW, ML $1.56 \times$ MH, mesopleuron smooth, flat area anterior to metapleural swelling smooth,

and T1L $1.65 \times$ T1W; *C. steineri* has frons rugose ventromesally and weakly coriaceous or smooth dorsomesally and laterally, ML $2.74\text{--}2.81 \times$ MW, ML $1.90\text{--}2.05 \times$ MH, mesopleuron coriaceous, flat area anterior to metapleural swelling rugulose to rugose, and T1L $1.94\text{--}2.20 \times$ T1W.

Description.—Female. *Body length*: 1.77 mm. *Head*: HL $0.73 \times$ HW, HW $0.95 \times$ TW, FW $0.73 \times$ FH, EL $0.43 \times$ EH, MNL $1.83 \times$ MNAW, MNAW $0.86 \times$ MNBW; labial palpus three-segmented; face smooth, setiferous; frons smooth, glabrous; gena and vertex smooth, setiferous; occiput smooth, glabrous; eye setiferous; clypeus with apical rim, setiferous; mandible with three teeth, setiferous except excavated distal portion glabrous, weak horizontal ridge present mesally, diagonal ridges associated with tooth 1 and 3 indiscernible, tooth 1 triangular, rounded apically, tooth 2 narrowly elongate, acute apically, tooth 3 orthogonal, rounded apically.

Mesosoma: ML $2.26 \times$ MW, ML $1.56 \times$ MH, MW $0.69 \times$ MH, SSL $0.27 \times$ SSW; pronotal collar weakly coriaceous anteriorly with two grooves converging posteromesally and crenulate posteriorly, pronope apparently absent but difficult to differentiate from grooves, lateral portion of pronotum coriaceous, setiferous along margins and glabrous mesally, anterolateral furrow rugose; notauli anteriorly carinate transverse grooves continuous with lateral margin of mesoscutum, crenulate, terminating as in Fig. 3; mesoscutal midpit absent; mesoscutum (excluding lateral margin, notauli, and midpit) weakly coriaceous, setiferous with setae slightly less dense posteromesally; scutellar sulcus bearing median longitudinal ridge and several small rugosities; scutellar disc smooth, setiferous; metanotal flange present; propodeum areolate-rugose with longitudinal carina mesobasally, setiferous; epicnemial carina absent; sternaulus present along entire length of mesopleuron,

anterior half crenulate and posterior half smooth; posterior mesopleural furrow entirely smooth; mesopleuron (excluding sternaulus and posterior mesopleural furrow) smooth except anterior margin dorsoventrally crenulate, setiferous dorsally and ventrally and glabrous laterally and mesally; metapleuron with smooth flat triangular area anteriorly and areolate-rugose swelling posteriorly, flat area and swelling setiferous, setae generally oriented posteroventrally.

Forewing: Hyaline; stigma with well-defined proximal and distal margins, semielliptical; vein r arising slightly basad middle of stigma; vein 3RS complete and tubular, evenly curved to anterior margin; veins 2RS and 1 m-cu complete and tubular; posterior half of vein (RS + M)a visible and tubular; 1st subdiscal cell closed, veins 2-1A and 2cu-a complete and tubular.

Hind wing: Hyaline; basal cell closed.

Metasoma: T1L 1.65× T1W; dorsoventrally flattened; ovipositor partially exerted, slightly visible dorsally; t1 aciculo-rugose, setiferous posterodorsally and laterally, dorsope present; t2-t3 weakly coriaceous; t4-t8 smooth; t2 setiferous posterolaterally, setae located in posterior half of tergite but in no apparent pattern, glabrous postero-mesally; t3 setiferous, setae located in posterior half of tergite and approximately in single transverse line, glabrous mesally; t4-t6 setiferous, setae located in posterior half of tergite and approximately in single transverse line.

Color: Head (excluding mouthparts and antenna) brown, mandible and palpi yellow, scape and pedicel yellow; mesosoma brown; forewing stigma and wing veins brownish yellow; legs yellow; t1 brown, t2 brownish yellow, t3 brownish yellow with posterior edge brown, t4-t8 brown.

Host.—Unknown.

Material examined.—*Holotype female*: Top label (white with red border; hand-

written) = "10554". Second label (green with black border; typewritten) = "Bs. Aires". Third label (white; handwritten) = "Gyrocampa [:] pallidinervis Br". Fourth label (white with red border; partially handwritten, partially typewritten) = "HOLOTYPE [:] Gyrocampa [:] pallidinervis [:] Brethes" (MACN).

Discussion.—The first author was unable to borrow the holotype of *Gyrocampa pallidinervis* Brèthes in order to verify its placement and redescribe it in Kula and Zolnerowich (2008). As detailed in Kula and Zolnerowich (2008), Riegel (1952) placed *C. pallidinervis* in *Chorebus* (presumably in the sense of Nixon 1943), Fischer (1997) placed it in *Chaenusa* s.l., and Marsh (in litt.) noted "exact generic placement uncertain." Kula and Zolnerowich (2008) also mentioned ambiguity regarding the location of the holotype, but the second author (JJM) located it in MACN. The first author examined the holotype, and it clearly fits *Chaenusa* s.l. as defined in Kula and Zolnerowich (2008).

In terms of Riegel (1950, 1982), *C. pallidinervis* cannot be placed unequivocally in *Chaenusa* s.s., *Chorebidea*, or *Chorebidella*. As in *C. aurantium*, the forewing first subdiscal cell is closed, the labial palpus is three-segmented, and forewing vein (RS + M)a is at least partially present. The forewing stigma is broad, a feature that partially defines *Chaenusa* s.s. and *Chorebidella*. *Chaenusa pallidinervis* is known only from females, and thus, gonoforceps shape is unknown.

Chaenusa quadriceps (Ashmead)

Distribution.—CANADA: Ontario, Quebec; USA: Illinois, Minnesota, Nebraska, New York, Wisconsin (Ashmead 1901, Riegel 1982, Kula and Zolnerowich 2008). USA, 5 ♂ *SOUTH DAKOTA, Black Hills near Mount Rushmore, 20.vi.1940, H. H. & J. A. Ross (EIU).

***Chaenusa steineri* Kula, new species**

(Figs. 8–14)

Diagnosis.—Characters used to differentiate *C. steineri* from all New World species of *Chaenusa* s.l. other than *C. pallidinervis* are presented in the diagnosis for *C. aurantium*. Characters used to differentiate *C. steineri* from *C. pallidinervis* are presented in the diagnosis for *C. pallidinervis*.

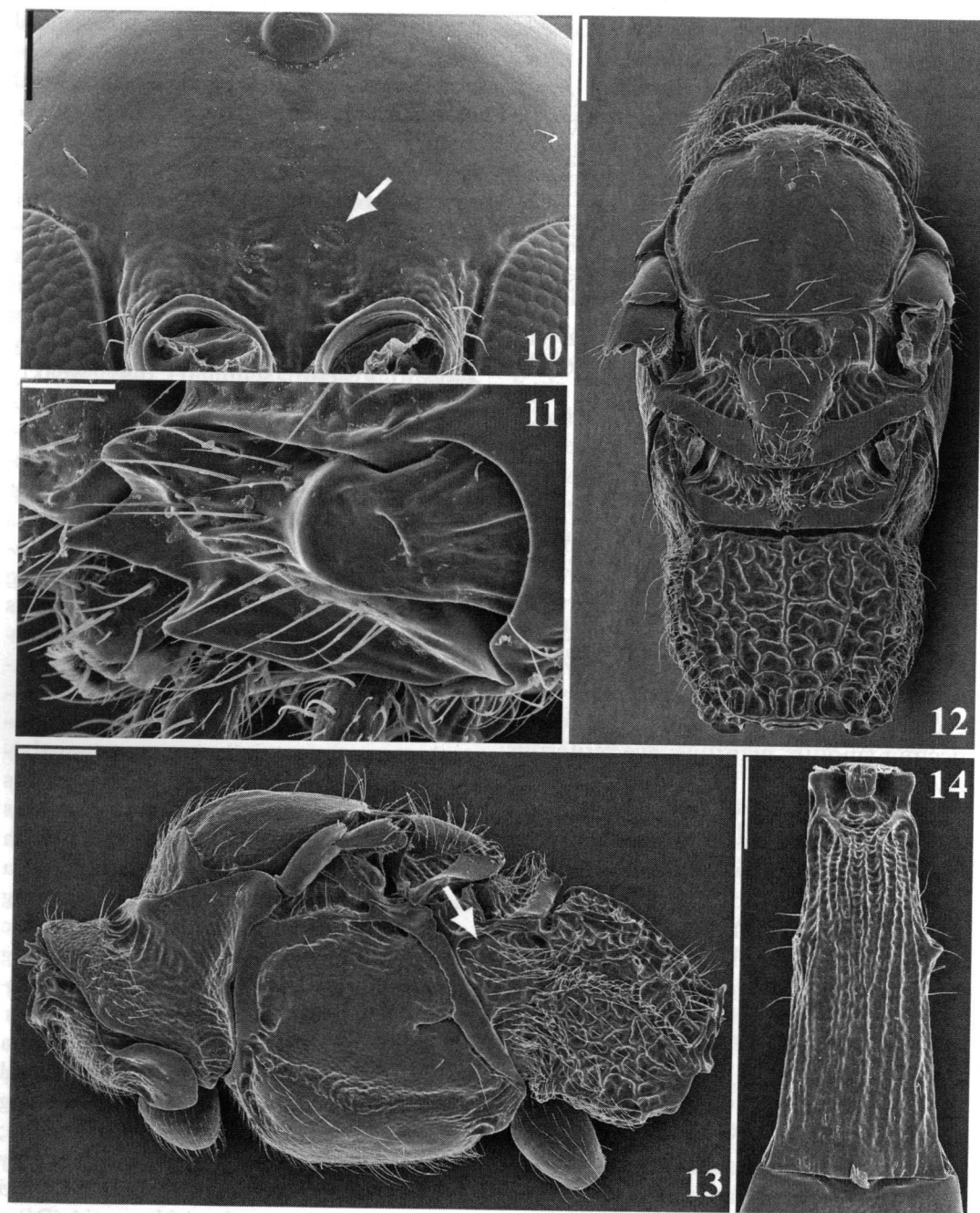
Description.—Male. *Body length:* 2.18–2.61 mm. *Head:* HL 0.82–0.92× HW, HW 0.93–1.00× TW, FW 0.82–1.00× FH, EL 0.52–0.64× EH, MNL 1.33–1.67× MNAW, MNAW 0.67–0.75× MNBW, F1L 1.00–1.17× F2L; antenna with 24–25 flagellomeres, maxillary palpus six-segmented, labial palpus three-segmented; face smooth or rugulose, setiferous; frons (Fig. 10) rugose ventromesally and weakly coriaceous or smooth dorsomesally and laterally, glabrous; gena and vertex weakly coriaceous or smooth, sparsely setiferous; occiput smooth, glabrous; eye setiferous; clypeus with apical rim, setiferous; mandible (Fig. 11) with three teeth, setiferous except excavated distal portion glabrous, rugulose mesally with diagonal ridges associated with tooth 1 and 3 weakly present but horizontal ridge indiscernible, tooth 1 triangular, rounded apically, tooth 2 narrowly elongate, acute apically, tooth 3 triangular or orthogonal, rounded apically.

Mesosoma (Figs. 12–13): ML 2.74–2.81× MW, ML 1.90–2.05× MH, MW 0.70–0.72× MH, SSL 0.45–0.50× SSW; pronotal collar coriaceous anteriorly and incompletely crenulate posteriorly (interrupted mesally), pronope present, lateral portion of pronotum coriaceous to rugose, setiferous along margins and glabrous mesally, anterolateral furrow rugose to coriaceous; notauli anteriorly carinate transverse grooves continuous with lateral margin of mesoscutum, smooth or crenulate, terminating anteriorly

or to mesoscutal midpit; mesoscutal midpit absent or slitlike; mesoscutum (excluding lateral margin, notauli, and midpit) coriaceous to weakly coriaceous, setiferous anteriorly, laterally, and mesally, setae located mesally often (75%) oriented roughly into two parallel rows terminating at posterior edge of mesoscutum; scutellar sulcus aciculo-rugose or rugose to rugulose, median longitudinal ridge often (60%) and small crenulae along posterior margin occasionally (40%) present; scutellar disc weakly coriaceous or smooth, setiferous; metanotal flange present; propodeum areolate-rugose, glabrous basally and setiferous apically; epicnemial carina present laterally but absent ventrally; sternaulus present along entire length of mesopleuron, entirely rugose or transitioning from crenulate anteriorly to coriaceous posteriorly; posterior mesopleural furrow entirely smooth; mesopleuron (excluding sternaulus and posterior mesopleural furrow) coriaceous except anterior margin partially rugose to partially dorsoventrally crenulate, setiferous dorsally and ventrally and glabrous laterally and mesally; metapleuron with rugulose to rugose flat triangular area anteriorly and areolate-rugose swelling posteriorly, flat area setiferous, setae generally oriented posteriorly, swelling setiferous, setae generally oriented posteroventrally.

Forewing (Fig. 8): Hyaline; stigma with well-defined proximal and distal margins, semielliptical; vein r arising slightly basad or from middle of stigma; vein 3RS complete and tubular, evenly curved to anterior margin; veins 2RS and 1 m-cu complete and tubular; vein (RS + M)a nebulous to complete and tubular or entirely absent; vein 1 m-cu basad vein 2RS; 1st subdiscal cell closed, veins 2-1A and 2cu-a complete and tubular.

Hind wing (Fig. 9): Hyaline; basal cell closed; subbasal cell closed, veins 1A and cu-a complete and tubular except mi-



Figs. 10–14. *Chenusa steineri*. 10, Frons, anterior view; arrow = rugose ventromesally, scale bar = 50 μm . 11, Mandible, lateral view; scale bar = 30 μm . 12, Mesosoma, dorsal view; scale bar = 100 μm . 13, Mesosoma, lateral view; arrow = rugulose anterior to metapleural swelling, scale bar = 100 μm . 14, Tergum 1, dorsal view; scale bar = 100 μm .

nutely spectral at posterodistal corner of cell.

Metasoma: T1L 1.94–2.20× T1W; dorsoventrally flattened; t1 (Fig. 14) aciculo-rugose, setiferous posterodorsally and laterally, dorsope present; t2 coriaceous to weakly coriaceous; t3 weakly coriaceous or smooth; t4–t8 smooth; t2 setiferous posterolaterally, setae located in posterior half of tergite but in no apparent pattern, glabrous posteromesally; t3–t5 setiferous, setae located in posterior half of tergite and approximately in single transverse line, often glabrous mesally (75%); t6–t7 setiferous, setae located in posterior half of tergite and approximately in single transverse line; t8 setiferous, setae in no apparent pattern.

Color: Head (excluding mouthparts and antenna) brown, mandible and palpi yellow, scape and pedicel yellow, flagellum entirely brown or transitioning from yellowish brown proximally to brown distally; mesosoma brown; forewing stigma and wing ventation brown; legs yellow except tarsus brownish yellow to yellowish brown with color gradually darkening proximally to distally; t1 brown, t2 orangish brown, t3 orangish brown with posterior edge brown, t4 entirely brown or orangish brown with posterior edge brown, t5–t8 brown.

Female. As in male except: **Head:** FW $0.67\times$ FH, MNAW $0.78\times$ MNBW; antenna with 23 flagellomeres.

Mesosoma: Sternaulus transitioning from rugose anteriorly to coriaceous posteriorly.

Metasoma: Ovipositor partially exserted, slightly visible dorsally.

Color: Flagellum transitioning from yellow proximally to brown distally.

Host.—Unknown.

Material examined.—**Holotype female:** Top label (white; typewritten) = “BOLIVIA: Beni, [.] 40 km E San Borja, [.] Estacion Biologica [.] Beni, Palm Camp at [.] Rio Curiraba [.] 9–15 Sept. 1987”.

Second label (white; typewritten) = “Malaise trap on [.] sand bar at [.] river bank [.] W. E. Steiner”. Third label (red; partially handwritten, partially typewritten) = “HOLOTYPE [.] *Chaenusa steineri* [.] Kula, 2010” (USNM). **Paratypes:** 3 ♂ same data as holotype; 1 ♂ BRITISH GUIANA [GUYANA]: Georgetown, Botanical Garden, A706, 26.ix.1918, H. Morrison (USNM). **Other material examined:** 1 ♂ same data as holotype (used for SEM).

Discussion.—In terms of Riegel (1950, 1982), *C. steineri* cannot be placed unequivocally in *Chaenusa* s.s., *Chorebi-dea*, or *Chorebidella*. As in *C. pallidiner-vis*, the forewing first subdiscal cell is closed, the labial palpus is three-segmented, and the forewing stigma is broad. Forewing vein (RS + M)a varies from complete and tubular to entirely absent, as Kula and Zolnerowich (2008) observed in *C. quadriceps* and *Chaenusa saxicola* (Riegel). The complete absence of (RS + M)a partially defines *Chorebidella*. Gonoforceps shape cannot be determined due to telescoping of the metasoma.

Chaenusa steineri exhibits sexual dimorphism in flagellomere number (23 females, 24–25 males) and FW: FH ratio (0.67 females, 0.82–1.00 males).

Etymology.—This species is named in honor of Warren E. Steiner, who collected the specimens from Bolivia, in recognition of his passion for insect natural history.

Chaenusa trumani Kula

Distribution.—USA: Georgia, Texas (Kula and Zolnerowich 2008). USA, 4 ♀ 12 ♂ *COLORADO: Eagle Co., 1.1 mi N junction Wurtz Ditch Rd. & Slide Lake Rd., 39°21.96'N 106°21.53'W, 8.viii.–10.viii.2005, M. Yoder & A. Bader, yellow pan traps, wlco_16 (3 ♀ 8 ♂ TAMU, 1 ♀ 4 ♂ USNM); 2 ♀ *ILLINOIS: Alexander Co., Middle Mississippi River Wetland Field Station, 0.5 mi S

junction IL-146 & Gerrard Road, 28.iv.–29.iv.2007, R. R. Kula, yellow pan traps in wooded wetland (USNM).

Chaenusa whartoni Kula

Distribution.—USA: Kansas, Nebraska (Kula and Zolnerowich 2008). *CANADA, 1 ♂ ONTARIO: Ottawa-Carleton Regional Municipality, Ottawa, Britannia Beach, 19.ix.–20.ix.2007, L. Masner, yellow pan traps (USNM). USA, 1 ♀ *OREGON: Deschutes Co., Deschutes River near Redmond, 19.vii.1939, Schuh & Gray (EIU).

Chaenusa woolleyi Kula

Distribution.—CANADA: Ontario; USA: Minnesota, Wisconsin (Kula and Zolnerowich 2008). USA, 2 ♀ *ILLINOIS: Lee Co., Amboy, 22.viii.1939, Ross & Riegel (EIU).

REVISED COUPLETS FOR KEY TO SPECIES
IN KULA AND ZOLNEROWICH (2008)

1. Mandible four-toothed (Kula and Zolnerowich 2008: figs. 5, 6, 16, 28, 34, 40, 46, 62)
... Couplet 2 in Kula and Zolnerowich (2008)
- Mandible three-toothed (Figs. 2, 11; Kula and Zolnerowich 2008: figs. 4, 52, 67) ... 10
- 10 (1). Forewing first subdiscal cell closed (Figs. 6, 8; Kula and Zolnerowich 2008: figs. 25, 38, 49, 65, 72) 10A
- Forewing first subdiscal cell open (Kula and Zolnerowich 2008: figs. 56, 60, 69)
... Couplet 11 in Kula and Zolnerowich (2008)
- 10A (10). Terminal maxillary palpomere brown; frons setiferous laterally and glabrous mesally (Fig. 1); female with head orange except ocellar triangle brown
... *Chaenusa aurantium* Kula and Martinez, n. sp.
- Terminal maxillary palpomere yellow; frons entirely glabrous (Fig. 10); female with head entirely brown 10B
- 10B (10A). Frons rugose ventromesally and weakly coriaceous or smooth dorsomesally and laterally (Fig. 10); mesopleuron coriaceous; flat area anterior to metapleural swelling rugulose to rugose (Fig. 13); ML 2.74–2.81× MW, ML 1.90–2.05× MH, TIL 1.94–2.20× TIW
..... *Chaenusa steineri* Kula, n. sp.

– Frons entirely smooth; mesopleuron smooth; flat area anterior to metapleural swelling smooth; ML 2.26× MW, ML 1.56× MH, TIL 1.65× TIW
..... *Chaenusa pallidinervis* (Brèthes)

ACKNOWLEDGMENTS

We thank Norma Díaz (MLP), Zhiwei Liu (EIU), Lubomir Masner (CNCI), Arturo Roig-Alsina (MACN), and Robert A. Wharton (TAMU) for providing specimens used in this study. We are grateful to Thomas J. Henry (Systematic Entomology Laboratory [SEL]), John W. Brown (SEL), and David R. Smith (collaborator, SEL) for reviewing the manuscript. Matthew L. Buffington (SEL) kindly provided assistance with digital imaging, and David Adamski (SEL) captured all original scanning electron micrographs.

LITERATURE CITED

- Ashmead, W. H. 1901. Descriptions of five new parasitic Hymenoptera, pp. 586–589. In Needham, J. G. and C. Betten, eds. Aquatic Insects in the Adirondacks. Bulletin of the New York State Museum 47: 383–612.
- Brèthes, J. 1913. Himenópteros de la América Meridional. Anales del Museo Nacional de Historia Natural de Buenos Aires 24: 35–160.
- Evenhuis, N. L. 2008. The Insect and Spider Collections of the World Website. Bishop Museum, Honolulu, <http://hbs.bishopmuseum.org/codens/codens-r-us.html> [accessed December 22, 2008].
- Fischer, M. 1997. Taxonomische Untersuchungen über Kieferwespen (Insecta: Hymenoptera: Braconidae: Alysini) der Alten Welt. Annalen des Naturhistorischen Museum in Wien 99: 97–143.
- Heraty, J. M. and D. Hawks. 1998. Hexamethyldisilazane: chemical alternative for drying insects. Entomological News 109: 369–374.
- Kula, R. R. 2009. A new species of *Chaenusa* (Hymenoptera: Braconidae) reared from *Hydrellia pakistanae* and *Hydrellia sarahae laticapsula* (Diptera: Ephydriidae) infesting *Hydrilla verticillata* (Alismatales: Hydrocharitaceae) in India and Pakistan. Florida Entomologist 92: 139–146.
- . 2008. Taxonomic status and location of type specimens for species of *Coelinidea* Viereck and *Sarops* Nixon (Hymenoptera: Braconidae: Alysini) described by Garland T. Riegel. Journal of Hymenoptera Research 17: 138–156.

- Kula, R. R. and G. Zolnerowich. 2005. A new species of *Epimicta* Förster (Hymenoptera: Braconidae) from North America and new distribution records for *Epimicta griffithsi* Wharton. *Proceedings of the Entomological Society of Washington* 107: 78–83.
- . 2008. Revision of New World *Chaenusa* Haliday *sensu lato* (Hymenoptera: Braconidae: Alysiinae), with new species, synonymies, hosts, and distribution records. *Proceedings of the Entomological Society of Washington* 110: 1–60.
- Nixon, G. E. J. 1943. A revision of the European Dacnusiini (Hym., Braconidae, Dacnusiinae). *The Entomologist's Monthly Magazine* 79: 20–34, 159–168.
- Riegel, G. T. 1950. A new genus and species of Dacnusiini (Hym.: Braconidae). *Entomological News* 61: 125–129.
- . 1952. Neotropical exodont Braconidae (Hymenoptera). *Transactions of the Illinois State Academy of Science* 45: 177–181.
- . 1982. The American species of Dacnusiinae, excluding certain Dacnusiini (Hymenoptera: Braconidae). *Novitates Arthropodae* 1: 1–185.
- Sharkey, M. J. and R. A. Wharton. 1997. Morphology and terminology, pp. 19–37. *In* Wharton, R. A., P. M. Marsh, and M. J. Sharkey, eds. *Manual of the New World Genera of the Family Braconidae* (Hymenoptera). Special Publication No. 1. International Society of Hymenopterists, Washington, D.C., 439 pp.
- USDA, NRCS. 2008. The PLANTS Database (<http://plants.usda.gov>). National Plant Data Center, Baton Rouge, Louisiana, USA. [accessed July 31, 2008].
- Wharton, R. A. 1977. New World *Aphaereta* species (Hymenoptera: Braconidae: Alysiinae), with a discussion of terminology used in the tribe Alysiini. *Annals of the Entomological Society of America* 70: 782–803.